Dancing Brains

Dance as a key motivator for success in mathematics

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Introduction

- Dance enhances cognitive function
- 85% of learners are predominantly kinesthetic learners (Jensen, 2010)
- Dance is:

  Uniquely suited to support conceptual learning because the dance vocabulary is expressed in terms of the body, space, time, and force – concepts also fundamental to understanding the universe (Overby, Post & Newman, 2005, Preface xi).
- Arts integrated models increase engagement and motivation to learn (Posner, 2009)

Image: © San Francisco Ballet

Context

Interdisciplinary approaches aiming to enhance achievement by improving engagement and attainment in "academic subjects"

(Royal Conservatory of Music; Burton, Horowitz & Abeles 1999).

Initiatives such as *Learning Through the Arts*, *ArtSmarts* and *Project Zero* (Canada, UK and US) (Catterall 2005; Upitis &Smithram [eds] 2003). In addition, dance practitioners such as Dr. Schaffer & Mr. Stern, Paul & Gail Dennison (*Brain Gym*) and Anne Green-Gilbert (*BrainDance*) use dance to teach cognitive skills, mathematics and other 'academic' subjects.

Insight from studies in neuroscience and related fields increasingly support the role of physical activity and dance in engagement and neuroplasticity, problem-solving and cognitive functions. In addition, the release of 'feel good' chemicals (such as serotonin) through dance activity may assist motivation (Gilbert 2006; Sousa 2000).

Image: © Dr Schaffer and Mr .Stern, MathDance

Academic connections

Neuroscientific studies show that movement and, therefore, dance has value in increasing attainment in academic subjects (Diamond 2000; Ratey 2001; Jensen 2005; Brehm 2007; Reed 2009; Mullender-Wijnsma et al, 2015).

Physical activity/dance and mathematics research. Cluster randomised control trial (Mullender-Wijnsma et al 2016) intervention: 499 children across 12 schools over 2 years built on physical activity short interventions. *Equivalent gain of 4 months learning compared to control group.* Anne Watson, Anne Green-Gilbert and a variety of practitioners support dance and mathematical links and learning. Panorea Baka founded Maths Dance workshops in 2013 to to support maths learning in Primary Schools, following her research.

Dance for learning Hanna (2015) draws from neurological, behavioural and cognitive sciences and a variety of theories as well as arts studies to support the role of dance for learning. Sandra Minton & Rima Faber (2016) and Mary Ann Brehm & Lynne McNett (2007) also support the role of dance in integrated learning in education and challenge a dualistic mindset that separates subject areas.

Movement and Cognition

Neuroscientific evidence that movement is "crucial to every other brain function, including memory, emotion, language and learning" (John Ratey 2001 in Brehm & McNett 2008, 20). Dance specific evidence is discussed in "The neuroscience of dance" (Brown, Parsons 2008).

Neurology and psychology support (Catterall 2005; Jensen 2000; Reed 2009; Van Braekel et al 2007) . Motivation and engagement links (Posner 2009; Catterall 2005).

Transfer of learning and dance: mainly anecdotal evidence as displayed in Keinänen, Hetland and Winner's extensive search of published and unpublished materials (2000, 295-306). However, increasingly, studies and scientific research are showing positive results for the use of dance in cognitive functions and motivation.

Dance + Mathematics

Shared elements and concepts = partnered learning opportunities

Examples of geometric links: choreography and geometry

Curricular connections: dance, PE, mathematics curricula

Numeracy is required (along with literacy) in all subjects

Active learning and teaching methods

Curricular links - examples

Mathematics KS 2 Notes and Guidance (non-statutory):

Pupils use the concept and language of angles to describe 'turn' by applying rotations, including in practical contexts (for example, pupils themselves moving in turns, giving instructions to other pupils to do so, and programming robots using instructions given in right angles). (Department for Education, 2014).

Dance & PE KS2

"a range of movement patterns" - learning how to use them in different ways and to link them to make actions and sequences of movement (2). (Department for Education, 2011, 2013).

Teacher Training – how many primary teacher training courses contain interdisciplinary mathematics training (or dance as a subject in itself)?

Image: © Universal Pictures. Rich Man's Frug from *Sweet Charity*.

Action research

Enhancing Mathematics Through Dance: an investigation into the possibility of raising attainment in primary geometry through the use of dance as a teaching tool (2010).

- Grade 2 and 3 students in a Canadian Elementary (Primary) school
- Control and Participant Groups in quasi experimental action research
- Learning preferences, attainment (demonstrated, oral and written) and enjoyment of mathematics and dance were examined
- Choreography: lessons included mathematical concepts matched with, and in addition to, choreographic devices and concepts
- Varied music also included some links to each lesson. For example, when exploring 5-sided shapes, I used Dave Brubeck's *Take Five*

Example of concepts included in Action Research project

Concepts/skills covered in a Grade 3 (Year 4) lesson:

Dance	**P.E.**	**Mathematics**
Pattern, direction	Pattern, direction	Patterns, shape, vertex
Control, choreography	Locomotor/non-locomotor	Quadrilateral
Shape, group work	Co-operation, leadership	Rectangular prism
Dance style, rhythm	Use of space, safety	Problem-solving
division		Edge, face, side

Selected results & findings

The majority of students in both participating classes were able to demonstrate their learning effectively through practical and oral means, with most students attaining percentages within ranges equating to pass marks in the *written* unit test.

Several observers in a performance of the choreographed pieces (whole school) indicated a desire to study mathematics using dance.

Enjoyment and/or learning gains bore no relation to gender.

64% of Grade 2 (Yr 3) students and 42% of Grade 3 (Yr 4) students thought it was easier to learn mathematics using dance.

Neither stated learning preferences, emotional responses to music nor enjoyment of the classes shared any noticeable correlation with attainment.

Most students stated that they enjoyed mathematics following the dance unit more than had done so before, and also enjoyed the unit most or all of the time.

Only pupils from the participatory group in Grade 3 attained 100% in the written test, despite control group extra time and access to vocabulary during the test.

Looking forward

- Collection of further data through engagement with schools would inform developments in use of interdisciplinary dance and mathematics
- Initial Teacher Training to include creative maths teaching using dance
- Implications for secondary, further and higher education, particularly for embodied learning